Proceedings of the

57th ANNUAL

NORTHWEST

FISH CULTURE CONFERENCE

"NORTHWEST FISH CULTURE FOR A SUSTAINABLE FUTURE"

December 4 - 6, 2006

"*People Producing Salmon*" by Kathryn Kostow

PREFACE

The U.S. Fish and Wildlife Service is pleased to welcome you to Portland, Oregon for the 57th Annual Northwest Fish Culture Conference. The Northwest Fish Culture Conference is an annual informal meeting that gathers fish culturists, scientists and interested individuals from private, state, provincial, tribal and federal hatchery facilities in the Pacific Northwest and elsewhere to exchange information and ideas about all aspects of fish culture. These conferences are hosted on a rotating basis by the various fisheries resource agencies in the Pacific Northwest. At the conferences, progress reports of management practices and problems, new developments, and research studies are presented. Both within the meeting and outside the formal meeting setting, active discussion, constructive criticism, and personal contacts are not only encouraged but actively cultivated. All persons interested in or associated with fish husbandry are invited to attend and to actively participate.

These Proceedings contain abstracts and manuscripts presented at the conference. They are unedited, contain progress reports of uncompleted programs, and, as such, should not be considered a formal peer-reviewed publication. Mention in these Proceedings does not indicate approval, recommendation, or endorsement of any proprietary product or material.

Conference Chairs:

Doug Olson, Craig Martin, & Amy Gaskill – U.S. Fish and Wildlife Service

Committees: (U.S. Fish and Wildlife Service staff)

Program: Mark Olson & Nathan Wiese
Registration: Margaret Anderson
Trade Show: Brett Gaylean & Mark Ahrens
IT Support: Tyler Marriot
Poster Session: Jim Bowker
Raffle Session: Susan Sawyer

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Matt Cooper, U.S. Fish and Wildlife Service

POSTER SESSION
Jim Bowker, U.S. Fish and Wildlife Service

NWFCC 2006 Final Schedule

DAY 1: Monday, December 4, 2006

9:00 Registration

1:00 Welcome/Announcements: Doug Olson, USFWS

1:10 Keynote Speakers: Dan Diggs, USFWS Assistant Regional Director – Region 1 Fisheries and Renne Lohoefener, Region 1 USFWS Director

SESSION #1: FISH HEALTH & NUTRITION
Session Chair: Ann Gannam, USFWS

1:30 **Jacob Gregg**, USGS – Biological Research Discipline, *Specific Pathogen Free Marine Fish: Developing tools for epizootiology.*

1:50 **Doug Munson**, Idaho Department of Fish and Game, *Benefits of Hatchery Management of BKD Using ELISA-based Culling.*

2:10 **Colleen Weiss**, Oregon Department of Fish and Wildlife, *Fish Tissue Collection Techniques and Basic Information on Routine Fish Health Examinations.*

2:30 **Craig Banner,** ODFW Fish Health, Oregon State University, *Initial Results from ODFW's Fish Health Survey of Naturally Produced Fish.*

2:50 **Dr. John E. Halver,** Professor Emeritus in Nutrition, School of Aquatic Fishery Science, University of Washington, *How Selenium and Ascorbate in Diet Intake Affect Fish Health.*

3:10-3:30 Afternoon Break / Raffle Drawing* (3:25)

SESSION #2: FISH HEALTH & NUTRITION
Session Chair: Ray Brunson, USFWS

3:30 **Diane Deal,** Oregon Department of Fish and Wildlife, *Ultraviolet Systems – Uses and Advantages.*

3:50 **Gerald Jones and John Kaufman,** ODFW Fish Health, *IHNV at Cole M. Rivers Hatchery, Rogue River Basin, Oregon.*

4:10 **S.K. Gutenberger,** U.S. Fish and Wildlife Service, Lower Columbia River Fish Health Center, *Use of Salmonid Carcasses for Nutrient Restoration: Disease Concerns and Treatments to Reduce Pathogen Transmission.*

4:30 **Darlene Snyder,** Idaho Department of Fish and Game, Hagerman State Fish Hatchery, *Hydrogen Peroxide Increases Survival of Rainbow Trout Fry at Hagerman State Fish Hatchery.*

4:50 **Dr. Jim Brackett**, Western Chemical Inc., *Applications of 35% PEROX-AID® as an External Microbicide for Freshwater Fish.*

5:10 **James D. Bowker,** U.S. Fish and Wildlife Service, *Impending Approval of Aquaflor® for Salmonids – A New Veterinary Feed Directive Antibiotic.*

5:30 Announcements/Adjourn (Raffle Drawing*)

5:30-10:00 Trade Show and Poster Session Social (light food & refreshments)

DAY 2: Morning Session, Tuesday, December 5, 2006

8:00 Announcements: Craig Martin, USFWS / Raffle Drawing*

SESSION #3: HATCHERY OPERATIONS AND NEW TECHNOLOGIES
Session Chair: Travis Collier, USFWS

8:10 **Randall L. Winters**, Bonneville Fish Hatchery, Oregon Department of Fish and Wildlife, *Overview of Salmon Production at Bonneville Fish Hatchery.*

8:30 **Loren C. Jensen**, Bonneville Fish Hatchery, Oregon Department of Fish and Wildlife, *Safe and Humane Harvest of Adult Salmon Brood Fish Returning to Bonneville Fish Hatchery.*

8:50 **Ryan Couture,** Oregon Department of Fish and Wildlife, Oregon Hatchery Research Center, *Oregon Hatchery Research Center – Facility Overview.*

9:10 **Caroline Peterschmidt,** Makah Fisheries Management, *Where the Research Meets the Road- Field Experiences and Results of a Calcein Marking Trial with Lake Ozette Sockeye.*

9:30 **Genny West,** PR Aqua, *Reusing Raceway and Circular Tank Water.*

9:50-10:20 Morning Break / Raffle Drawing* (10:15)

SESSION #4: HATCHERY OPERATIONS AND NEW TECHNOLOGIES
Session Chair: Larry Telles, USFWS

10:20 **Robert C. Endicott,** NOAA Fisheries, Northwest Fisheries Science Center, *A New Temperature-based Growth Program to Improve Feeding Strategies at Hatcheries: a Freeware Application Compiled in Visual Basic.*

10:40 **Theresa Godin,** Freshwater Fisheries Society of BC, *Sterile and All-Female Kokanee Development for Recreational Fisheries.*

11:00 **Dan Magneson,** U.S. Fish and Wildlife Service, Willard National Fish Hatchery, *Use of Shade Structures at Willard National Fish Hatchery.*

11:20 **Harry Heise,** Specialty Coating Solutions, *The Rehabilitation and Coating of the Walhalla Fish Hatchery Twenty–Four (24) Concrete Raceways.*

11:40 **Benedikt Hálfdanarson,** Vaki Aquaculture Systems Ltd, *Identifying Fish Sex and Species With Riverwatcher Camera Fish Counter.*

12:00 – 1:10 Lunch / Raffle Drawing* (1:05)

Afternoon Session, Tuesday, December 5, 2006
SESSION #5: SUSTAINABLE FISH CULTURE
Session Chair: Julie Collins, USFWS

1:10	**Lee Blankenship,** Northwest Marine Technology, *Hatchery Reform in the Pacific Northwest.*
1:30	**Douglas DeHart,** U.S. Fish and Wildlife Service, Pacific Region, *U.S. Fish and Wildlife Service Columbia Basin Hatchery Reviews.*
1:50	**William J. Bosch,** Yakama Nation Fisheries – Yakima Klickitat Fisheries Project *Evaluating the use of Kelt Reconditioning to Rebuild Steelhead Populations in the Yakima River, Washington*.
2:10	**Greg Taylor,** U.S. Army Corps of Engineers, *Evaluating the Success of Outplanting Adult Spring Chinook Salmon (Oncorhynchus tshawytscha) in the North Fork of the Middle Fork Willamette River, Oregon.*
2:30	**Steven Roberts**, Washington Department of Fish and Wildlife, *The Last Spawning: Completion of the Hatchery Phase of Tucannon River Spring Chinook Captive Broodstock Program.*

2:50 - 3:20 Afternoon Break / Raffle Drawing* (3:15)

SESSION #6: SUSTAINABLE FISH CULTURE
Session Chair: Jim Bowker, USFWS

3:20	**Carlin McAuley**, NOAA Fisheries**,** *Captive Broodstock Programs for Endangered Snake River Spring Chinook – Life in a 20' Ocean – The Manchester Experience.*
3:40	**Timothy L. Hoffnagle**, Oregon Department of Fish and Wildlife, Northeast Region Fish Research, *The Grande Ronde Basin Chinook Salmon Captive Broodstock: F_1 Generation.*
4:00	**Travis Anderson,** U.S. Fish and Wildlife Service, Lahontan NFH, *The Development of the Pilot Peak Strain of Lahontan Cutthroat Trout at Lahontan National Fish Hatchery.*
4:20	**Ray Jones,** U.S. Fish and Wildlife Service, Idaho Fishery Resource Office, *Evaluation of Clearwater Steelhead Stock Performance in Serial Re-use Raceways at Hagerman National Fish Hatchery.*
4:40	**Cory Kamphaus,** Yakama Nation, Fisheries Resource Management, Use of Natural and Semi-Natural Juvenile Rearing Ponds and Applicability to Mid-Columbia Coho Reintroduction.
5:00	**Geraldine Vander Haegen,** Northwest Marine Technology, Inc. *Coded Wire Tags and Pacific Salmon Hatcheries.*

5:20 Announcements/Adjourn (Raffle Drawing*)

DAY 3: Morning Session, Wednesday, December 6, 2006
8:00-8:10 Announcements: Amy Gaskill, USFWS (Raffle Drawing*)

SESSION #7: AQUATIC NUISANCE SPECIES AND HACCP
Session Chair: Paul Heimowitz, USFWS

8:10 **John W. Hitron,** U.S. Fish and Wildlife Service, Carson NFH, *Eastern Brook Trout in Tyee Spring / Creek: Water Supply for Carson National Fish Hatchery.*

8:30 **Leyla Arsan,** Oregon State University, *Potential Dispersal of the Non-native Myxobolus cerebalis. A Qualitative Analysis of Risk for the Willamette River Basin, Oregon.*

8:50 **Jordan Nielson,** University of Idaho, USGS Cooperative Fish and Wildlife Research Unit, *Progress on Methods of Controlling New Zealand Mudsnails (Potamopyrgus antipodarum) in Fish Hatcheries.*

9:10 **Paul Heimowitz,** U.S. Fish and Wildlife Service, Aquatic Invasive Species and Research, *What's the (Critical Control) Point of HACCP: Minimizing the Spread of Aquatic Invasive Species.*

9:30 **ANS Panel Discussion,** John Hitron, Leyla Arsan, Jordan Nielson, & Paul Heimowitz, *Aquatic Nuisance Species and HACCP related to Fish Culture.*

9:50 – 10:20 Morning Break / Raffle Drawing* (10:15)

SESSION #8: SUSTAINABLE FISH CULTURE cont.
Session Chair: Matt Cooper, USFWS

10:20 Fish Culture Hall of Fame Inductions by Tim Yesaki and Speros Doulos

10:40 **Jerry Marco,** Colville Confederated Tribes, *Chief Joseph Hatchery, Approaching Final Design.*

11:00 **Caine Brand,** Chiwawa Ponds/Lake Wenatchee Net Pens, *Supplementing For Sustainable Future- Chiwawa Ponds/Lake Wenatchee Net Pens.*

11:20 **Robert E. Null,** U.S. Fish and Wildlife Service, *Post-spawn Movement and Iteroparity of Hatchery-Origin Steelhead Kelts in the Central Valley of California.*

11:40 **Nathan Wiese**, U.S. Fish and Wildlife Service, Hagerman NFH, *Production Capacity Assessment of Steelhead at Hagerman National Fish Hatchery.*

12:00 Closing Remarks / Adjourn / NWFCC Artwork Raffle, Grand Prize Raffle Drawing*

Must be present to win at Raffle Drawings!

POSTER SESSION: Monday, December 4, 2006, 5:30-7:30

1. **Rod Engle,** U.S. Fish and Wildlife Service, Columbia River Fisheries Program Office, *Techniques for Evaluating a Fry Release Strategy for Tule Fall Chinook Salmon at Spring Creek National Fish Hatchery.*
2. **David Hand,** U.S. Fish and Wildlife Service, Columbia River Fisheries Program Office, *Adult Hatchery Fish in the Stream: An Evaluation of an Outplanting Program to Increase Natural Production.*
3. **Maureen Kavanagh,** U.S. Fish and Wildlife Service, Columbia River Fisheries Program Office, *Assessing the Impacts of Hatchery Released Fish on Native and ESA Listed Species.*
4. **Doug Olson and Mary Peters,** U.S. Fish and Wildlife Service, *The Effect of Erythromycin Feed Treatments on Prevalence of Bacterial Kidney Disease and Subsequent Survival of Spring Chinook Salmon at an Oregon Hatchery.*
5. **Oregon Chapter of the American Fisheries Society.**
6. **Ron G. Twibell,** U.S. Fish and Wildlife Service, Abernathy Fish Technology Center, *Effects of a Commercial All-Plant Protein Diet on Growth Responses and Tissue Contaminant Levels in Coastal Cutthroat Trout.*
7. **David L. G. Noakes,** Oregon State University & OHRC Fisheries & Wildlife Department, Oregon State University, Corvallis Oregon**,** *The Oregon Hatchery Research Center: Searching for Answers.*
8. **Cheri Anderson,** U.S. Fish and Wildlife Service, *Columbia River Gorge Information & Education Office.*
9. **Susan Sawyer,** U.S. Fish and Wildlife Service, *Dworshak Fisheries Complex: Small town, Large fish, Big Complex, LOTS of Outreach.*
10. **Mark C. Nelson,** U.S. Fish and Wildlife Service, Mid-Columbia River Fishery Resource Office, *Juvenile Pacific Lamprey Use of a Pollution Abatement Pond on the Entiat National Fish Hatchery.*
11. **Corky Broaddus,** U.S. Fish and Wildlife Service, *Leavenworth National Fish Hatchery Complex.*

ABSTRACTS – TECHNICAL PAPERS

FISH HEALTH/NUTRITION

Specific Pathogen Free Marine Fish: Developing Tools For Epizootiology

Jacob Gregg*,Cristy Pacheco, Paul Hershberger

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The study of disease processes in wild marine fish populations is severely limited by the lack of pathogen free, immunologically naïve animals. Investigations using wild marine fish with unknown infection/disease histories have lead to equivocal results with regard to pathogen virulence, host susceptibility, and potential reductions in fitness. At the Marrowstone Marine Field Station (USGS) we are adapting aquaculture techniques to produce Specific Pathogen Free (SPF) marine fish. Larval marine fish require live feeds initially and often have limited capacity for prey detection. Additionally, the nutritional requirements of most marine fishes are not known. These difficulties coupled with the need to prevent the introduction of pathogens or antigens make rearing SPF marine fish difficult and methods are being adapted on a species by species basis. To date Pacific Herring (*Clupea pallasii*), Copper Rockfish (*Sebastes caurinus*), and Brown Rockfish (*S. auriculatus*) have been reared through metamorphosis, and three year classes of SPF herring are being maintained at our facility. Currently epizootiology includes work with Viral Hemorrhagic Septicemia Virus, Erythrocytic Necrosis Virus, Infectious Hematopoietic Necrosis Virus, *Ichthyophonus hoferi* and others.

Benefits of Hatchery Management of BKD Using ELISA-based Culling

A. Douglas Munson* and Keith A. Johnson

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Idaho Department of Fish and Game (IDFG) has managed *Renibacterium salmoninarum,* the causative agent of bacterial kidney disease (BKD), in hatchery Chinook salmon *Oncorhynchus tshawytscha* dating back to 1969. We have successfully controlled clinical BKD by utilizing the following management strategy since 1993 consisting of: (1) intra-peritoneal injection of erythromycin to returning adult salmon; (2) iodophor disinfection of eggs during water hardening; (3) usually culling the eggs of females with ELISA optical densities greater than 0.25, to reduce the risk of vertical transmission; (4) application of two prophylactic feedings of erythromycin; (5) and when necessary, high BKD segregation groups are released separately from the low/negative BKD rearing groups. ELISA-based culling of broodstock is the cornerstone of this management strategy. The success of this program is documented by mortality records, routine inspection, and diagnostic sampling during the 18 month period of hatchery rearing and routine inspection sampling of returning adults. Once ELISA-based culling was added to this strategy, this program experienced the following benefits in hatchery Chinook: (1) reducing pre-spawning mortality due to BKD at Rapid River Hatchery; (2) reducing cumulative mortality from ponding to release in juveniles; (3) improving smolt to adult survival; (4) and increasing the percent of adult females with optical densities less than 0.25. This strategy has been instrumental in reducing the risk of vertical and subsequent horizontal transmission of BKD in all Chinook hatcheries operated by IDFG. We recommend this management strategy for programs considered risk intolerant to BKD.

Fish Tissue Collection Techniques and Basic Information on Routine Fish Health Examinations

Colleen Weiss*

Oregon Department of Fish and Wildlife, Bonneville Captive Brood Program, 70543 NE Herman Loop Cascade Locks, OR 97014. (541) 374-2255.

Hatcheries depend upon Fish Health Specialists to help control fish diseases and maintain healthy fish populations. Fish Health Specialists rely on hatchery staff to provide details that may help clarify the diagnoses and slow the spread of infection. Proper collection, identification, description and shipment of fish or fish tissues are critical for determination of the problem.

There are two areas that hatchery staff should consider when a fish loss occurs.

1) Proper tissue preparations for fish health examinations (sample storage, identification and packaging in ice).
2) Different types of examinations regularly preformed on fish tissue samples (general fish health, whirling disease, bacterial cultures, viral cultures and ELISA-bacterial kidney disease).

Using the proper techniques of fish tissue collection, labeling, and shipping will make analysis of the tissues cleaner, easier and more efficient. Cleaner, less fragrant samples will enhance your relationship with your Fish Health Specialist, provide better results and make your job more enjoyable.

Initial Results from ODFW's Fish Health Survey of Naturally Produced Fish

Craig Banner*

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ODFW's fish health monitoring program directed toward fish reproducing in the wild is in its second full year. Fish captured in the wild are being examined for parasites, viruses and *Renibacterium salmoninarum* and *Myxobolus cerebralis,* if appropriate. Resulting data is added to a fish health database. Although numbers of fish examined from each site are low, it is hoped that yearly or seasonal additions of data will result in an invaluable source of information in the future. In an effort to maximize use of sampled fish, samples taken during annual fish inventories and other fish sampling programs are being examined. Results of the survey to date will be presented and the rational for undertaking the program will be discussed.

How Selenium and Ascorbate in Diet Intake Affect Fish Health

Dr. John E. Halver

Professor Emeritus in Nutrition, School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA 98195-5020, email: halver@u.washington.edu

Vitamin C, the major inter and intra cellular reducing agent, has roles in multiple biochemical processes in fish health. Primary focus has been on tissue anabolism and resistance to disease. A major secondary role has recently been identified—acting as a reducing agent to keep glutathione peroxidase in the active state by keeping the Se in the enzyme in the reduced state. This enzyme, GTPX, is the major protecting enzyme to minimize peroxidation of the polyunsaturated fatty acids in the lipo-protein structure of cell membranes. This is of critical importance for gill cell membranes during smolt to sea water transition. Disastrous results in survival occur when inadequate levels of C and Se are in the diet.

Recent experiments have shown fish under stress mobilize tissue stores of Se and C to enable production of GTPX to protect the lipo-proteins from loss of integrity by oxidation and consequent rupture of the DHA and EPA fatty acids of these vital membranes.

Other experiments have shown brain tissue gene expression for GTPX and SOD when dietary imbalance of fatty acids occurs. These two major oxidation limiting enzymes require C for keeping the metal component of the enzyme in the reduced and active state for activity. This new role for ascorbate to keep metaloenzymes in the active state opens new avenues for dietary intake research and implementation to assure fish under stress, and especially fish transferring to a salt water environment, have adequate stores of Se, C and perhaps Cu and Zn to meet these physiological challenges.

Ultraviolet Systems - Uses and Advantages

Diane Deal*

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The most important need in aquaculture is a pathogen free water source.

Over the last decade, new innovations such as ozone plants have been used to provide a pathogen free water supply. But, cost effectiveness of these plants can be prohibitive, with an added concern of environmental impact.

Well water is also a source of pathogen free water in aquaculture, but running pumps and chillers contributes to high utility expenditures.

Utilization of ultraviolet as a source of safe and simple water disinfection has the following advantages:

1. Treatment of influent, effluent, and water used in recirculation
2. Pathogen free water for early rearing and/or juvenile rearing
3. Total suspended solids filtration from hatchery water supply to maintain better compliance with environmental control
4. Increase productivity at rearing facilities creating the ability to bring in out-of-basin stocks and treat the effluent water
5. Development of natural rearing environments

Through the cooperative effort of the USFWS, Oregon Department of Fish & Wildlife, The Nez Perce Tribe, and Confederated Tribes of Umatilla, an Ultraviolet system was installed at Lookingglass Hatchery and was brought on-line in March of 2006. This treats Lookingglass Creek influent water which is Lookingglass Hatchery's main water supply. The following pathogens have been found in this system:

1. Infectious Hematopoietic Necrosis, [IHN]
2. R Bacterium - Bacterial Kidney Disease, [BKD]
3. Yersinia Ruckeri – Enteric Redmouth, [ERM]
4. Aeromonas salmonicida – Furunculosis
5. Felxibacter psychrophilus – Bacterial Coldwater Disease

Lookingglass FH now has the ability to produce alternative pathogen free water other than well water and expand the hatchery's rearing opportunities.

IHNV at Cole M. Rivers Hatchery, Rogue River Basin, Oregon

Gerald Jones *, and John Kaufman*

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Infectious hematopoietic necrosis virus (IHNV) was isolated at Cole M. Rivers Hatchery from 1989 through 1993 in adult Chinook and Coho salmon, and summer steelhead. Losses occurred in ChS fry only in 1991. From 1994 to 2003 IHNV had not been isolated from any stock at the hatchery. In 2004 a prespawning adult ChS mortality in a holding pond was found to be carrying IHNV. Subsequent sampling of 144 spawning adult ChS failed to detect IHNV. In early 2005, spawning adult summer steelhead (52.00) and winter steelhead (52.00 and 62.00) were found to have high prevalence of IHNV. In July of 2005, juvenile Rbt (72T04) experienced increased mortality and were confirmed IHNV positive. In early May 2006 several ripe adult steelhead (up to 60) from a population which had a high prevalence of IHNV, escaped a holding pen into the water supply lines of the hatchery. In the ensuing weeks, many of the fish were flushed out of the system and re-captured, although not all were accounted for. In early June 2006, juvenile Rbt experienced an increased loss and were determined to be IHNV positive. Mortality in this group ultimately reached about 85%. Winter steelhead juveniles also tested positive for the virus (52 and 62 stocks), as did other out of basin stocks which were subsequently euthanized. In August 2006, Summer steelhead (52) juveniles, which were ponded in June and were experiencing an epizootic of coldwater disease were confirmed positive for IHNV.

Use of Salmonid Carcasses for Nutrient Restoration: Disease Concerns and Treatments to Reduce Pathogen Transmission

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Adding salmonid carcasses to nutrient-poor streams in the Pacific Northwest improves productivity for fish and other biota. However, the use of carcasses for nutrient enrichment can pose a disease risk to the native fish. Returning adult salmon often have infectious hematopoietic necrosis virus (IHNV), which can survive in the sediment for months and potentially infect salmonid fry emerging from spawning beds. Virus concentrates in ovarian fluid, internal organs, and gills so either removal of these organs or destruction of the virus is necessary to prevent possible spread of the pathogen. Hypothesizing that evisceration and/or heat treatment (by sun-baking or oven) would reduce or kill virus, we examined 30 freshly killed, spring chinook salmon in spawning condition. Virus load was measured in ovarian fluid, gill and internal organs, and muscle before and after a simple heat treatment of the carcasses to 86^{o}F. Based on the carcasses sampled, it is estimated that virus load was reduced by 100-fold by evisceration and 10,000-fold for the heat treatment. It is suspected that these methods will also reduce some but not all bacterial and viral pathogens. The spore-forming parasites (e.g., whirling disease agent *Myxobolus cerebralis*) will not be killed by these methods, and it is questionable whether *Renibacterium salmoninarum* (agent of bacterial kidney disease, BKD) is affected. It is therefore important to know the health history of the stock and to avoid planting fish, especially mortalities, from outside the watershed. Evisceration may somewhat reduce levels of antibiotic but the safest option is to use fish which haven't been treated. The Warm Springs National Fish Hatchery and the Yakama Nation's Prosser Hatchery have been using variations of the evisceration/heat treatments of salmon carcasses for nutrient supplementation and their modifications will be discussed.

Hydrogen Peroxide Increases Survival of Rainbow Trout Fry at Hagerman State Fish Hatchery

Darlene Snyder*

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Rainbow trout Oncorhynchus gairdneri production at Hagerman State Fish Hatchery has been greatly impacted by both bacterial coldwater disease and *Icthyobodo sp.* infestation. Historically, hatchery survival from egg to 700 fish-per-pound (1.5 grams) has been highly variable with extended periods of less than 50% survival. For the past five years hydrogen peroxide has been used on an as-needed basis when fish were diagnosed with an epizootic due to the diseases mentioned above. This year an experiment was designed to determine the efficacy of hydrogen peroxide as a preventative treatment for bacterial coldwater disease and *Icthyobodo sp.* infestation. Hydrogen peroxide treatments of 0 ppm, 100 ppm and 200 ppm were randomly assigned to hatchery vats stocked with rainbow trout eggs purchased from Troutlodge. Eggs and fry were treated daily for 49 days. Initial data shows survival for 0 ppm, 100 ppm and 200 ppm to be 62.8%, 81.9% and 80.8% respectively. The use of hydrogen peroxide at Hagerman State Fish Hatchery has increased the survival rate in the hatchery. This increase in production has allowed a reduction in the number of eggs needed to fulfill our stocking requests which in turn has reduced the costs of producing rainbow trout fry.

Applications of 35% PEROX-AID® as an External Microbicide for Freshwater Fish

Jim Brackett[1]*, Ron Malnor[1], and David Lovetro[2]

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[2]Akzo Nobel / Eka Chemicals Inc.

Hatchery reared freshwater fish require treatment with an external microbicide at the egg stage and at various times during culture in commercial and government fish culture facilities. Externally applied treatments are required for treating fungal and bacterial infections during these phases of culture. Hydrogen Peroxide has been considered by the US Food and Drug Administration as a low regulatory priority (LRP) drug since 1994. Hydrogen Peroxide as a 35% solution from Eka Chemicals has been used as an LRP for egg and fish treatments. It is anticipated that Eka Chemicals' 35% PEROX-AID® will receive approval from FDA in the near future. The status and specific considerations for use of the product will be discussed.

Impending Approval of Aquaflor® for Salmonids – A New Veterinary Feed Directive Antibiotic

James D. Bowker*

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Good news! Aquaflor®, the first new in-feed antibiotic for U.S. aquaculture in more than 20 years, has been licensed by the U. S. Food and Drug Administration (FDA) for use in channel catfish. That's great for catfish producers, but what's the benefit of this new approval to those who culture a fish species other than catfish. The answer is that more good news is on the way. The sponsor of this drug, Schering Plough Animal Health Corp.(Morris, NJ), is working towards expanding the catfish approval to include use in salmonids. The initial approval for all freshwater salmonids will be to control mortality caused by coldwater disease. This approval should soon be expanded to include use to control morality caused by furunculosis and columnaris. It is important to note that Aquaflor® is the first feed antibiotic in aquaculture, and only second for all food-animal species, to be classified by FDA as a Veterinary Feed Directive (VFD) drug. In the past, the FDA had only two categories of approved animal drugs: over the counter (OTC) and prescription. Drugs intended for use in animal feeds were classified as OTC drugs. As newer, more effective drugs were developed, the FDA's Center for Veterinary Medicine (CVM) recognized that these drugs, particularly antimicrobials, should be approved for use in animal feeds, but that more control over their use was needed than OTC status provided. What does this mean and how does it affect the ability of the fish culturist to be able to legally use this (soon-to-be) approved product? This presentation will outline the steps in the VFD process, describe the responsibilities of the veterinarian, producer, and the feed mill/distributor, and provide an overview of the data that was generated to support an approval for use of Aquaflor® to control mortality in all freshwater fish caused by coldwater disease, furunculosis, and columnaris.

HATCHERY OPERATIONS & NEW TECHNOLOGY

Overview of Salmon Production at Bonneville Fish Hatchery

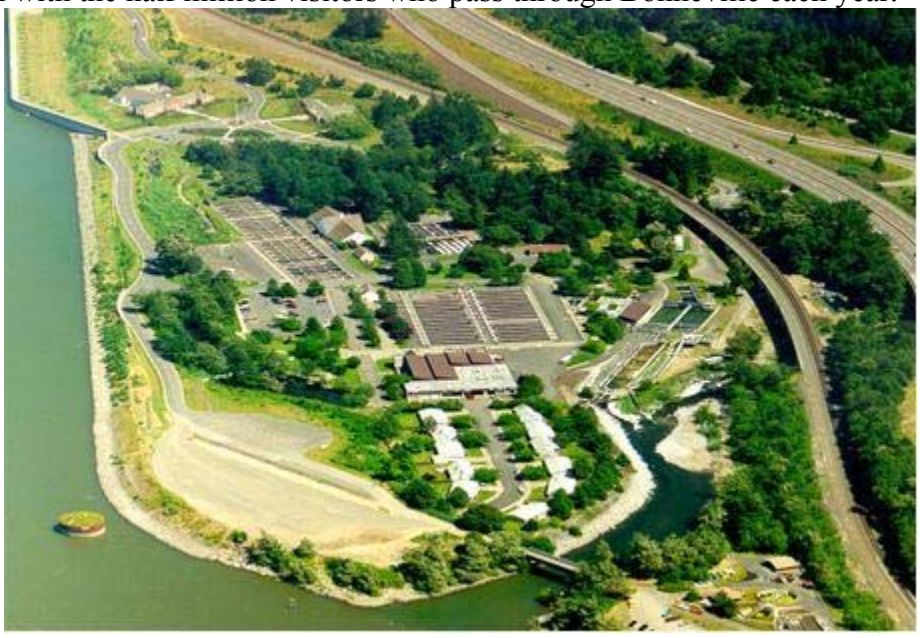
Randall L. Winters*

Bonneville Fish Hatchery, Oregon Department of Fish and Wildlife, 70543 NE Herman Loop, Cascade Locks, OR 97014. Phone: (541)-374-8393. Fax: (541)-374-8090. E-mail: bvhatchery@saw.net

Bonneville Hatchery is located just west of Cascade Locks, Oregon at Bonneville Dam on the Columbia River at RM 145.5. The rearing facilities include 30 raceways, 28 modified Burrows raceways and 3 adult holding ponds. The hatchery water supply is obtained from two sources; Tanner Cr. and seven wells producing up to 18,000 gpm. The hatchery currently receives funding from both NOAA (Mitchell Act) and the USACE (Corps of Engineers).

The hatchery production associated with Mitchell Act funding produces Lower River Coho that will contribute to the NE Pacific and Columbia River Basin commercial and sport fisheries.

The hatchery production associated with the US Army Corps of Engineers mitigation agreement produces juvenile Fall Chinook in numbers which are equal to the loss of wild Fall Chinook spawners and habitat caused by the construction of the John Day Dam.
In 1999, construction was completed on a 2.1 million dollar facility to accommodate the Grand Rhonde Basin Spring Chinook Captive Brood Program.
Bonneville is also the home to “Herman the Sturgeon” a 10 foot White Sturgeon whose residence is an underwater viewing facility for the public. Herman is a very popular attraction with the half million visitors who pass through Bonneville each year.



Safe and Humane Harvest of Adult Salmon Brood Fish Returning to Bonneville Fish Hatchery

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Killing of brood fish in hatcheries is a necessary component of the spawning process. Using traditional methods, fish are lightly sedated and generally killed by clubbing the fish on the head. The two main concerns of this method are issues of safety / operator injury and public perception. While manual clubbing is normally effective as a rapid killing method, there is a generally held perception that it is inhumane.

A new compact device developed by Seafood Innovations in Australia uses a pneumatically powered percussive blow to instantly stun fish when they enter the machine and contact the trigger mechanism. After stunning, the fish continue through and exit the machine. The device is known as the SI-5 Fish Stunner and has been adapted for brood fish from a similar machine used in the commercial harvesting of farmed salmon in Canada, Australia and Scotland.

Oregon Hatchery Research Center- Facility Overview

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The Oregon Hatchery Research Center (OHRC) provides a wide range of options for investigating the effects of spawning, incubation and rearing treatments on the growth, survival, reproductive success and other performances of hatchery and wild fish. The OHRC's mission is to develop an understanding of the mechanisms that may create differences between hatchery and wild fish and devise ways to reduce and manage the differences so that hatcheries can be used responsibly in the conservation and use of Oregon's native fish.

The Oregon Hatchery Research Center was built on the site of the former Fall Creek Hatchery. Originally constructed in 1952, this facility originally consisted of ten raceways, one large asphalt rearing pond, and one adult holding pond with a fish ladder and trap. Although a few buildings and structures were unchanged, the majority of the facility was demolished and new buildings were built and modernized.

Facility Improvements:

1. New Water Intake
2. New Fish Ladder/Trap
3. New Silt Settling Pond
4. New Simulated Streams
5. New Tank Farm
6. Refurbished Research Raceways
7. New Research Building

The mission of the OHRC is to:

- Understand mechanisms that may create differences between hatchery and wild fish.
- Develop approaches to manage hatchery fish that conserve and protect native fish.
- Educate the public on the relationship between hatchery and wild fish, the connection between fish and watershed, estuarine and ocean systems, and the implications for fish management and stewardship.

Where the Research Meets the Road- Field Experiences and Results of a Calcein Marking Trial with Lake Ozette Sockeye

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The Makah Tribe has monitored the smolt outmigration of Lake Ozette Sockeye for six seasons, refining methods and equipment almost annually. Goals of monitoring include total population and hatchery contribution estimation. In past years, ad-marking has been the only way to differentiate hatchery produced sockeye smolts from natural sockeye smolts without lethal sampling, which has left hatchery fed fry releases unaccounted for at smolt outmigration. To evaluate calcein dye as a method to identify these hatchery fry releases, all of the 2005 hatchery sockeye were calcein dipped prior to release. Calcein monitoring was done at the smolt trap during the 2006 outmigration season with good success with identification of both fingerling and fed fry hatchery releases, providing not only total hatchery contribution but relative contributions of fed fry and fingerling releases. Results and in-field experiences in testing this new method and equipment will be presented.

Reusing Raceway and Circular Tank Water

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Water reuse technologies are commonly applied in circular tank systems where, depending on fish density, 50% to 90% of the water can be reused without any more treatment than solids removal and aeration. Raceway culture systems have typically been designed as flow-through systems. However, water shortages and high pumping costs have resulted in many flow-through facilities looking for ways to reuse water.

Serial reuse of raceway water where water is passed from one raceway to another is relatively common. Low head oxygenation equipment such as LHO's™ are being used to oxygenate the water. However, production in these facilities is limited by the carbon dioxide concentration. Because of its high solubility, removing carbon dioxide requires contacting the water with large volumes of air.

PR Aqua is currently working with Fisheries and Oceans Canada on a pilot study at an enhancement facility using raceways. We are installing a combination CO_2 stripper/LHO™ stacked unit in the head of a raceway. Water from the discharge end of the raceway will be returned to the head of the raceway after passing through the combination CO_2 stripper and LHO™. Solids will be minimized by drawing water from high in the raceway water column. It is expected that pumping costs will be 1/5 that of the current water supply and that water consumption will be reduced by as much as 60%. Data will be collected beginning in mid-September with the return of brood stock, and we expect to be able to present our findings at the North West Fish Culture Conference.

A New Temperature-based Growth Program to Improve Feeding Strategies at Hatcheries: a Freeware Application Compiled in Visual Basic

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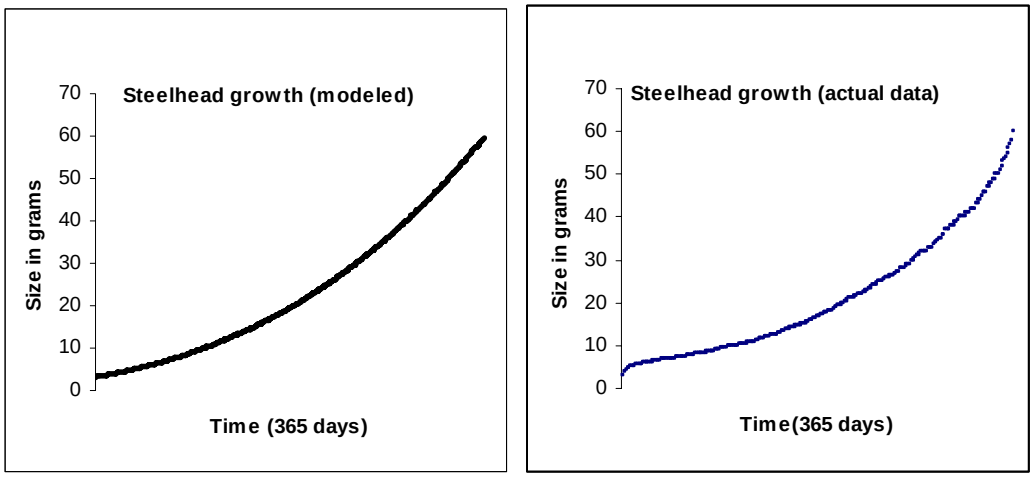
Traditional approaches to feeding salmonids reared in hatcheries often implement ration guidelines developed by various feed manufacturers. These guidelines typically suggest rations for maximum growth at certain temperatures and fish size as a percent of biomass. While it may be beneficial to achieve maximum growth in hatcheries, there are instances where a slower, controlled growth rate is more desirable. Recent research has suggested that releasing hatchery reared salmonid juveniles and smolts into watersheds at sizes similar to wild conspecifics of the same age may reduce negative ecological interactions. Different facilities within a geographic region that rear salmonids under divergent temperature regimes may wish to attain a congruent size during a planned release period or match the seasonal growth of wild salmonids. For these situations, a temperature-based growth model can greatly assist fish culturists in reaching a desired fish size on a pre-determined date. The current presentation discusses the basis for one such model, different strategies for implementing it, and access to the programming code and copies of the software itself. The program, which incorporates a growth algorithm proposed by Iwama and Tautz (1981), allows the user to input initial fish weight, temperature, rearing duration and a target fish weight. The software produces rations for a specified period in a Microsoft Word file.

Figure 1. Steelhead growth as it was modeled over a period of approximately 365 days (left graph). A ration was extrapolated by the model and fed accordingly. The right graph shows data from sample weights of juvenile steelhead taken over 365 days.



Sterile and All-Female Kokanee Development for Recreational Fisheries

Theresa Godin*

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The Freshwater Fisheries Society of BC has been producing sterile kokanee *Oncorhynchus nerka* for recreation fisheries for four years. Early stock assessments indicate that sterile kokanee, like their non-sterile counterparts, have a proportion of males that exhibit secondary sex characteristics and false spawning behaviour at age 2, sometimes even before recruitment into the fishery. The production of mono-sex female sterile kokanee (AF3n) would help address this issue. Stocking AF3n kokanee may improve the quality of the fishery, reduce early maturation mortality, and reduce both the genetic risk and interaction risk to wild fish populations.

The first step to producing a mono-sex female stock is to change females into phenotypic males (XX males). The Freshwater Fisheries Society of BC produces XX male rainbow trout and brook trout using both immersion and dietary protocols with α-methyltestosterone (MT) depending on the species. Experimental trials to masculinize kokanee were conducted at Clearwater Trout Hatchery in December 2005. Three replicates of mixed-sex eyed eggs and alevins were subjected to a double immersion bath in one of four concentrations of α-methyltestosterone for two hours. The initial immersion was at 75% hatch and the second was one week later. Sex ratios of kokanee in the treatment groups are compared to that of the control. Results will be presented during the 2006 Northwest Fish Culture Conference.

Use of Shade Structures at Willard National Fish Hatchery (NFH)

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"Sunburn" in coho salmon at Willard National Fish Hatchery was formerly a chronic problem during the summer, first appearing shortly after transfer from the indoor nursery tanks into the outdoor 8' X 80' concrete raceways. This problem would then disappear after the intensity of the sunlight began to wane in autumn. Although the white lesion associated with sunburn was evident only on a small segment of the population, and most of these fish later recovered, the asymptomatic fish were no doubt also experiencing a heightened level of stress and, overall, a generally deteriorated state of health and well-being.

Beginning in the late 1990's, different approaches to providing shade over the raceways were tried. Although these early attempts to shade the fish were largely successful in eliminating sunburn, they also left a lot to be desired: to varying degrees, they generally were in the way of such practices as feeding, cleaning and crowding. These methods also shaded less area than would be ideal, often sheltering only portions of the raceways. They also needed to be put in place each spring and subsequently taken down again each fall to avoid potential snowfall.

In early 2004, the Yakama Nation provided a new style of shade structure to Willard NFH. Incorporating an "A"-shaped design and constructed of 3" X 3" steel, they are far stronger than quonset-style shade structures utilizing tubular aluminum. These new structures also utilize 100% polypropylene tarps. This material has a slick surface that, when coupled with the steep slope, better sheds snow down through the comparatively-wide openings and into the raceway. Thus these shade structures can be left in a functional position year-round. Covering an equivalent number of raceways, the new structures are also less than 1/20 the cost of a metal-roofed structure.

The new shade structures were in place and ready for use when we ponded the BY03 coho. The fish responded extremely well to this new environment, spreading out and utilizing the entire raceway and in turn lending themselves to being both more easily fed and better fed. We also had the opportunity to start fish under these structures and they proved quite conducive to this.

These structures also serve to shelter employees from the elements and - especially - shields them from the sun. The new structures also seem to deter avian predation and generally reduce algal/moss growth. Currently, we are rearing our 3rd brood year of coho under these structures since their use first began in May 2004. Most importantly of all, no sign of sunburn has been evident in the coho we have reared under these structures.

The Rehabilitation and Coating of the Walhalla Fish Hatchery Twenty-Four (24) Concrete Raceways

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The Walhalla Fish Hatchery is operated by the South Carolina Department of Natural Resources (SCDNR). Construction of the Walhalla hatchery began in the 1930's with the first release of trout in about 1937. The original rearing tanks were small circular pools. The present twenty-four (24) concrete raceways and newer buildings were constructed in the 1950's and 1960's. Originally the hatchery was operated by the Bureau of Sport Fisheries, Department of Commerce. Next it was under the direction of the U.S. Fish and Wildlife Service, Department of the Interior. In January 1996, the supervision of this hatchery was transferred to the South Carolina Department of Natural Resources.

In 2005 the SCDNR funded a project to rehabilitate and coat about 40,000 square feet of twenty-four concrete raceways which had been neglected and exhibited medium to severe concrete erosion. An architect/engineering firm was retained to develop a project engineering scope to implement this project without impeding on the fish production and enhance the overall hatchery operations. It was determined to implement this project over the winter months when the fish population in the raceways is at a minimum.

The project was divided into three phases. Fish were transferred from eight raceways to the remaining sixteen, where work commenced to rehabilitate and coat the raceways. Upon completion of the initial phase and within a very short operating window, fish were transferred back into the completed raceways. Once again for phase two, fish were transferred from the next set of eight raceways where the rehabilitation and coating process continued until all the raceways were completed in three phases.

This paper will discuss the stringent project schedule; raceway surface preparations; the selection of materials that are stronger than concrete, can be applied and function at temperatures below 32F; and finally, the successful completion of the project.

Identifying Fish Sex and Species With Riverwatcher Camera Fish Counter

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The Riverwatcher fish counter is used in many different rivers to monitor fish migration in fishways and ladders all over the world. The Riverwatcher consists of two scanner plates, using infra red light to scan silhouette images of fish swimming through the scanner opening. Each individual image is memorised in the control unit so that the counting can be verified afterwards. These images are used to calculate the size of every fish, so accurate information on number, size and direction is acquired. The temperature of the water is also measured, as well as the date and time of day that each fish passes the counter. With accurate information on the migration pattern it is possible to

- make comparison of catch figures and the movement pattern of the fish to calculate the exploitation rate
- compare the movement pattern of the fish from one year to another
- evaluate the results of rearing and smolt releases
- assess the influence of different environmental factors
- assess the efficiency of a fish ladder
- get valuable data for better fisheries management

and with the latest camera connection module, the Riverwatcher now gives data for

- identification of species, sex, wild/farmed fish etc.

The new digital camera system records videos or still images of fish passing through the scanner. The scanner is used to trigger the camera to capture 1 to 5 digital photos or a short video clip of each fish. The computer then automatically links the digital images to the other information contained in the database for that fish such as size, passing hour, speed, silhouette image, temperature etc. By using this new system for species and sex recognition it is easy to scroll through the database and sort fish into predefined categories.

SUSTAINABLE FISH CULTURE

Hatchery Reform in the Pacific Northwest

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The Hatchery Reform Project began in FY2000 when the U.S. Congress funded the Puget Sound and Coastal Washington hatchery Reform Project. In FY2006 Congress provided funding to start a review of Columbia River Basin hatcheries. The project is a systematic, science-driven redesign of how hatcheries can be used to achieve the goals of: 1) helping to recover and conserve naturally spawning populations and 2) supporting sustainable fisheries. The project has three structural components. These include the Hatchery Scientific Review Group (HSRG; independent science), Coordinating Committee (tribal and agency policy) and Facilitation Group. The HSRG has developed a series of tools for evaluation purposes which include a scientific framework for Artificial Propagation of Salmon and Steelhead, a benefit risk assessment, and a set of hatchery operational guidelines. A set of monitoring and evaluation criteria is currently being developed (Managing for Success) which provides the co-managers with a transport tool that has the ability to track and identify progress in implementation of hatchery reform measures on a stock by stock basis.

The HSRG has three basic principles to guide hatchery management: 1) goals for all stocks must be explicitly stated in terms of desired benefits, 2) the purpose, operation and management of each hatchery program must be scientifically defensible and consistent with current scientific knowledge; and 3) decisions must be informed and modified by continuous evaluation and new scientific information.

The HSRG review of Puget Sound and Coastal Washington hatcheries was completed in FY2005 and has entered the implementation phase. The Columbia Basin review started this year with emphasis on lower river and Mitchell Act hatcheries. Completion of Columbia Basin hatchery reviews is expected in 2008.

U.S. Fish and Wildlife Service Columbia Basin Hatchery Reviews

Douglas DeHart* and Don Campton

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U.S. Fish and Wildlife Service (FWS) has initiated a series of reviews of National Fish Hatcheries (NFH) in the Columbia Basin using the scientific principles and review procedures developed during the Western Washington Hatchery Reform Project. The hatchery review team has completed reviews and recommendations for production programs at Warm Springs NFH and Leavenworth NFH complex. Recommendations include operational modifications to improve existing production programs and program modifications to better integrate production into subbasin management and restoration strategies. Reviews of NFHs in the lower Columbia are now underway. Reviews and recommendations for all Columbia Basin NFHs are expected to be completed by late 2007.

Evaluating the use of Kelt Reconditioning to Rebuild Steelhead Populations in the Yakima River, Washington

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Populations of wild steelhead in the Columbia River Basin have declined dramatically and are listed under the Endangered Species Act. One approach to increase abundance and productivity of steelhead populations is to capitalize on their inherent iteroparity by artificially reconditioning post-spawners (kelts). From 2001-2005, the Yakama Nation and cooperators tested the use of short- and long-term reconditioning as methods for increasing the survival and repeat spawning rates of steelhead kelts in the Yakima River in south central Washington State. In short-term reconditioning, kelts were held for approximately 3-9 weeks to initiate post-spawning feeding, and were then transported around downriver hydroelectric facilities and released, with natural rearing and re-maturation occurring in the ocean. In long-term reconditioning, kelts were reared for 6-8 months in a captive environment to reinitiate feeding, grow, and re-mature. Survival to release for short-term reconditioning ranged from 69-93% and averaged 79%. Post-release survival and return of short-term kelts to the Yakima River ranged from 1-9% with returning "ocean-reared" kelts showing an average weight gain of 46%. Survival to release for long-term reconditioning ranged from 19-62% and averaged 36% with captive-reared kelts showing an average weight gain of 38%. Short- and long-term reconditioned steelhead kelts represented 2-11% of the annual spawning escapement in the Yakima River from 2001 to 2005. Radio telemetry results demonstrated success in locating spawning grounds and constructing redds. An analysis of pre- and post-spawning weights of long-term reconditioned kelt females and returning wild steelhead showed that kelt females lost significantly less weight during the spawning period, possibly indicating that long-term reconditioned females were less reproductively successful than their wild counterparts. We are conducting a detailed reproductive success study of artificially reconditioned kelt steelhead and investigating changes to long-term reconditioning methods to ensure females' eggs are not resorbed or overripe.

Evaluating the Success of Outplanting Adult Spring Chinook Salmon (Oncorhynchus tshawytscha) in the North Fork of the Middle Fork Willamette River, Oregon

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The U.S. Army Corps of Engineers (USACE) operates and maintains a system of 13 dams and reservoirs within the Willamette River Basin located in northwest Oregon. These dams block access to a majority of the historic spawning habitat for spring chinook (*Oncorhynchus tshawytscha*) in the basin. Since the 1990's, the Oregon Department of Fish and Wildlife has been outplanting hatchery spring chinook salmon upstream of dams in the Willamette Basin to provide nutrient enhancement, a prey base for native resident fish, and later as a means of supplementing natural production of spring chinook salmon. To evaluate the success of this outplanting program, we established the distribution and pre-spawning mortality rate of radio tagged adult spring chinook released into the North Fork of the Middle Fork Willamette River in 2004-2006. In addition, USACE biologists collected mortalities for analysis to determine potential causes of death and conducted spawning surveys to calculate a fish / redd ratio as a metric to compare success between years. In 2006, ODFW implemented improved handling protocols and treated outplanted chinook with antibiotics. Date of release influenced distribution and the rate of pre-spawning mortality observed in radio tagged fish. Estimates of pre-spawning mortality ranged from 2 to 100 percent. Estimates of pre-spawning mortality were significantly lower in 2006 than compared to 2004-05. The contribution of improved handling protocols, antibiotic treatment, or environmental conditions to the lower pre-spawning mortality rate observed in 2006 is unclear. Analysis of recovered carcasses identified the presence of furunculosis and bacterial kidney disease. Fish / redd ratios for outplanted fish differed between years. Improving survival of adult chinook outplanted into historic habitat above Corps of Engineers Dams is an important step towards establishing and maintaining a viable population of naturally reproducing spring Chinook salmon in the Middle Fork Willamette Subbasin.

The Last Spawning: Completion of the Hatchery Phase of Tucannon River Spring Chinook Captive Broodstock Program

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Washington Department of Fish & Wildlife initiated a captive broodstock program for the Tucannon River spring Chinook salmon at Lyons Ferry Hatchery in 1997. The overall goal of the captive broodstock program was short-term preservation and rebuilding of this critically depressed ESA listed Tucannon River spring Chinook. The program goal was to rear captive broodstock selected from retuning adults to maturity, spawn them, and rear to release 150,000 smolts annually into the Tucannon River, in southeast Washington. The captive broodstock program was completed with spawning four year old females from 2002 broodyear in late summer, 2006. Survival of the captive broodstock was excellent with no bacterial kidney disease or other fish health problems encountered. Captive broodstock matured earlier than returning anadromous adults. Captive males matured at age one to three and females at ages three to five. Fish size and fecundity was lower in captive fish but egg size was comparable. Also, captive brood spawned later then returning anadromous fish. Lower egg survival was the only major problem encountered. The number of smolts released from 2003 to 2006 was 75% (range 30% to 94%) of the goal. A future presentation will report on adult returns which are expected through 2011.

Captive Broodstock Programs for Endangered Snake River Spring Chinook – Life in a 20ft. Ocean – The Manchester Experience

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In 1995, the Idaho Department of Fish and Game (IDFG), the Oregon Department of Fish and Wildlife (ODFW), the Nez Perce Tribe (NPT), the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), and the Shoshone-Bannock Tribes, in cooperation with National Oceanic and Atmospheric Administration Fisheries (NOAA Fisheries), established a cooperative captive broodstock program to aid in recovery of six stocks of Snake River Spring Chinook listed as threatened in 1992 under the Endangered Species Act.

Captive broodstocks are a form of artificial propagation in which fish are cultured in captivity for their entire life cycle. Increased survival in protective culture rapidly increases population size, accelerating recovery efforts by producing large numbers of offspring that can be returned to the wild.

Both programs employ similar rearing strategies throughout most of the lifecycle – collection of wild eggs or parr, rearing in freshwater to smolt, rearing from smolt to adult in seawater, and final maturation in freshwater. The programs diverge at this point with ODFW spawning adults in the hatchery and releasing smolts into their natal streams and IDFG releasing adults for volitional spawning into their natal streams.

A brief history of both programs is provided with a main focus on the challenges of captive chinook rearing in a pumped seawater facility at the NOAA Manchester Research Station.

The Grande Ronde Basin Chinook Salmon Captive Broodstock Program: F1 Generation

Timothy L. Hoffnagle* and Richard W. Carmichael

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The Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program began in 1995 with collection of the 1994 brood year. The program collects wild parr and rears them in captivity under one of two pre-smolt (accelerated vs. natural) and post-smolt (freshwater vs. saltwater) growth regimes. At maturation, the adults are spawned and their offspring reared to smoltification, at which time they are released into the streams from which their parents were collected. F_1 smolt production was lower than expected due to lower than expected growth and smolt-to-adult survival of Captive Broodstock and low egg-to-smolt survival of the F_1 generation. The F_1 generation starts with fewer eggs but ends with more smolts than natural salmon due to lower natural egg-to-smolt survival. F_1 smolts were larger than natural smolts. The F_1 smolt-to-adult survival rate was generally lower than that of natural salmon but exceeded program goals. F_1 smolt survival to Lower Granite Dam, run timing and spawning distribution were similar to those of natural salmon. F_1 adults also matured at a younger age than natural salmon. The Captive Broodstock Program has helped increase the number of naturally spawning adults in the Grande Ronde Basin but the true measure of success will be self-sufficiency.

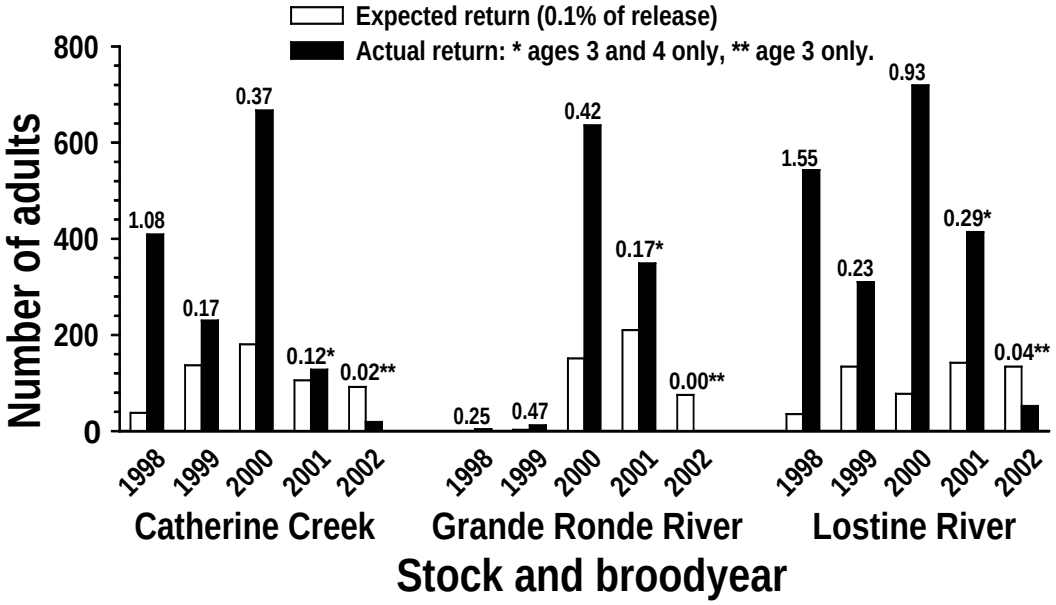

Figure 1. Expected and actual returns and smolt-to-adult return rates (numbers above columns) of F_1 generation Captive Broodstock Chinook salmon from the Grande Ronde Basin, Oregon, 1998-2002 brood years.

The Development of the Pilot Peak Strain of Lahontan Cutthroat Trout at Lahontan National Fish Hatchery

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Lahontan National Fish Hatchery (NFH) is part of the Lahontan NFH Complex which includes the Fisheries Field Office in Reno, Nevada; the Marble Bluff Fish Facility in Nixon, Nevada; and the Lahontan NFH in Gardnerville, Nevada. The Lahontan NFH plays a critical role in the recovery of the threatened Lahontan cutthroat trout (LCT). Efforts to establish a captive LCT broodstock began in 1996. This broodstock was developed from a remnant population of LCT discovered in the 1970's in Morrison Creek located on the eastern slope of the Pilot Peak Mountains in northwestern Utah. An overview of the Pilot Peak LCT broodstock program, including a summary of study results addressing temperature requirements and ovulation timing, will be presented.

Evaluation of Clearwater Steelhead Stock Performance in Serial Re-Use Raceways at Hagerman National Fish Hatchery

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Hagerman National Fish Hatchery rears Clearwater stock summer steelhead as part of the Lower Snake River Compensation Plan program. Smolts are raised from eyed eggs and released into the upper Salmon and Little Salmon rivers for sport and Tribal harvest. During its hatchery life cycle, the Clearwater stock exhibits a late winter/early spring spike in mortality, unlike the other two stocks of summer steelhead being raised at Hagerman NFH. The Hagerman Hatchery Evaluation Team (HET) conducted an evaluation to determine if Clearwater stock mortality is influenced by the degree of serial reuse, since the hatchery typically rears the fish in the lower deck of its serial three-pass system of raceways. To evaluate the situation, Clearwater stock was raised in replicate raceways on all three decks for two consecutive years. Mortality, water quality, and fish health were monitored and compared with the same parameters for Sawtooth stock summer steelhead. The study did not include the evaluation of either downstream migration or adult returns. The results indicate that the abnormal spike in mortality during the hatchery life cycle of the Clearwater stock is not measurably influenced by the degree of water re-use at the hatchery.

Use of Natural and Semi-Natural Juvenile Rearing Ponds and Applicability to Mid-Columbia Coho Reintroduction

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The mid-Columbia Coho Reintroduction Project has made extensive use of natural ponds for acclimating coho pre-smolts prior to release. These cost-effective ponds have facilitated effective reintroduction of coho salmon to the Wenatchee River. Benefits of using natural ponds for acclimation include the ability to increase the spatial distribution of returning adults by allowing for multiple sites throughout a basin, and the production of hatchery smolts which may have some 'wild' characteristics. These characteristics include a diet which incorporates invertebrates as a supplemental food source, cryptic coloration of juveniles, and natural emigration timing through volitional releases. Survival rates (release-to McNary Dam, and SARs) of coho released from natural ponds has been comparable to those released from concrete ponds. In-pond survival is being measured with PIT tags. The reintroduction of coho salmon to the Wenatchee River is proving to be successful with increasing spawning escapements and natural production. Use of natural ponds for acclimation has played an important role in the success of the program, aiding in increased dispersal of the returning adults. Natural ponds have become the preferred acclimation strategy of the Yakama Nation's mid-Columbia coho reintroduction program.

Coded Wire Tags and Pacific Salmon Hatcheries

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The Pacific Northwest's coded wire tagging program for Pacific Salmon is the largest animal tagging program in history, and is a great example of what can be achieved through international and interstate cooperation. Since its inception, more than 1.1 billion salmon have been released with coded wire tags, and over 5 million tags have been recovered. The information gathered from coded wire tags represents the work of thousands of scientists, technicians, hatchery personnel, and policymakers. It provides information vital to making harvest management decisions, to understanding the effects of different hatchery practices, to evaluating the distribution and contribution of released fish, and to numerous studies about fish biology and ecology. Hatchery personnel in particular have considerable influence on the quality of the data gathered given that about 95% of tags released are in hatchery fish, and about half of all tags are recovered at hatcheries. This talk will review the coded wire tag program and some of its contributions to hatchery programs and fish management, and stock recovery. It will also describe experiments evaluating electronic detection and highlight new technologies available for detecting tags.

AQUATIC NUISANCE SPECIES AND HACCP

Eastern Brook Trout in Tyee Spring / Creek: Water Supply for Carson National Fish Hatchery

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The historical presence of Eastern Brook Trout in Tyee Spring / Creek has presented a challenge to the stocking practices of Carson NFH.

Insofar as Eastern brook Trout may compete with Bull Trout, a listed species, occupying the same water body, stocking has become problematic in many cases.

U. S. Fish & Wildlife policies strongly support listed designations and fall in complete compliance with ESA requirements.

Tyee Spring / Creek represents one of the finest hatchery water supplies in the entire region.

To that end, significant efforts have been made to ensure that the water supply to Carson NFH is free of Eastern Brook Trout.

Those inquiries and methods currently underway are described.

Potential Dispersal of the Non-native Parasite Myxobolus cerebralis: A Qualitative Analysis of Risk for the Willamette River Basin, Oregon

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Myxobolus cerebralis, the cause of salmonid whirling disease, was first detected in Oregon in 1986 in the far Northeast section of the state and the Snake River Tributaries. Since then, it has been detected in stray adult salmon and steelhead in the Deschutes River and in juvenile rainbow trout from a private rearing facility on a tributary of the Clackamas River. This study examines the risk of introduction and establishment of the parasite into the Willamette River. There are numerous potential introduction routes throughout the Columbia River Basin including: movement of fish by humans, dispersal of parasite via birds and predatory fish, angler activities, and dissemination by stray anadromous fish from enzootic areas. Establishment is dependent upon several variables including: tubificid host populations and distributions, and water temperature. This risk assessment will give managers a better understanding of where to allocate resources to help prevent further spread and effects of the pathogen. It will also provide decision-makers with tools to assess management implications and to eliminate non-issues by using logical scientific arguments.

Progress on Methods of Controlling New Zealand Mudsnails (Potamopyrgus antipodarum) in Fish Hatcheries

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New Zealand Mudsnail (*Potamopyrgus antipodarum;* NZMS) infestations at fish hatcheries can limit or restrict the options for stocking hatchery-reared fish because of the risks of spreading snails to new locations. Reliable and environmentally friendly methods that remove NZMS from source waters would be helpful to hatchery managers by creating an environment for snail–free fish production and/or transportation. In this study we are evaluating a two-step control method for the piped spring water supply of the Hagerman National Fish Hatchery (NFH) - - hydrocyclonic separation of NZMS followed by carbonation of the hydrocyclone waste (snail) stream. Recent tests within and outside of USGS have demonstrated that aquatic species are generally intolerant to forced increases in dissolved carbon dioxide concentrations (DC) given its effect on water, blood, and hemolymph pH. These species are also sensitive to elevated total dissolved gas pressures. The gas bubble trauma that develops following exposure can, as with elevated DC exposure, cause mortality. We are exploiting this sensitivity by developing a control method based on manipulation of DC under both atmospheric and hyperbaric pressure conditions. Tests to date show elevation of DC is effective at controlling all life stages of the NZMS - - neonates, juveniles and adults. Required exposure periods are relatively short and decrease with increasing temperature or gas supersaturation levels. Hydrocyclones use centrifugal forces to separate solids from liquids without use of moving parts. Capital costs are relatively low and power requirements are satisfied by line pressures present at Hagerman and other fish hatcheries. Our analysis of NZMS particle size distributions, combined with proprietary simulation tools (Krebs Engineering, Tucson Arizona), suggest hydrocyclonic separation of NZMS will be complete. Planned field verification trials at the Hagerman NFH will test separation efficiency of a 400L/min capacity hydrocyclone as a function of NZMS particle size, system geometry and hydraulic loading rate.

What's the (Critical Control) Point of HACCP: Minimizing the Spread of Aquatic Invasive Species

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Prevention continues to prove the best defense against the mounting impacts of aquatic invasive species like zebra mussels and silver carp. The Hazard Analysis and Critical Control Point (HACCP) process has been used for years to reduce the risk of food contamination, but its use to minimize the spread of invasive species is still evolving. HACCP provides for a step-by-step analysis of a particular operation to identify vulnerabilities for inadvertent transport of unwanted species, and then helps pinpoint the most effective opportunities for closing those pathways. But identifying critical control points and associated control methods during initial development of a HACCP plan isn't enough. The continuing flow of new invasive species into the region requires frequent updates to ensure that all relevant risks are addressed. Further, best management practices that result from HACCP only matter if they're implemented, and even then they don't always eliminate a particular risk. Therefore, a key but sometimes-neglected aspect of a HACCP plan is the associated corrective action that can be triggered when an invasive species control limit isn't met. A number of existing HACCP plans can help illustrate how to make this process successful. If developed properly and implemented effectively, HACCP can help fish culture facilities avoid costly operating restrictions and serious environmental impacts. More information and resources for HACCP plan development can be found at www.haccp-nrm.org.

Chief Joseph Hatchery, Approaching Final Design

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The Colville Confederated Tribes are completing Step 2 planning and preliminary engineering for the Chief Joseph Hatchery to be located on the Columbia River at river mile 543, immediately below Chief Joseph Dam. The facility is being designed to rear 2 million yearling and sub-yearling summer/fall Chinook and 900,000 yearling spring Chinook.

The proposed programs will use 5 acclimation sites along the Okanogan River and tributaries to rebuild summer/fall Chinook production in historical habitat and reintroduce extirpated spring Chinook. Releases directly from the hatchery will support ceremonial and subsistence (C&S) tribal fisheries. Fisheries from S.E. Alaska to the Okanogan River will also benefit. The Colville Tribes are developing complementary live-capture, selective fishing gears to collect local broodstock and target harvest on hatchery-origin Chinook to promote viability of the naturally spawning populations.

The hatchery will have a unique water supply from Rufus Woods Lake, the relief tunnel at Chief Joseph Dam and a prolific well field. Water sources are substantial and will allow mixing to achieve optimal incubation, rearing, and holding temperatures for Chinook. A highly cost-effective facility is anticipated.

The spring Chinook program may use broodstock from Leavenworth NFH (segregated harvest program) and/or ESA-listed Methow Composite broodstock from Winthrop NFH (integrated conservation program). Initial broodstock selection is pending an ongoing review of the USFWS' hatchery programs and ESA recovery planning.

Initiated as mitigation for the Federal Columbia River Power System, the hatchery programs may now also be cost shared with one or more mid-Columbia Public Utility Districts (PUD) as mitigation for PUD dams. Substantial PUD participation may increase the planned capacity of the hatchery.

Chief Joseph Hatchery promises to provide the cornerstone for the Colville Tribes' long-waited-for mitigation to restore C&S fisheries.

Supplementing For Sustainable Future - Chiwawa Ponds/Lake Wenatchee Net Pens

Caine Brand *, Marc Babiar

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Chiwawa and Lake Wenatchee evolution and contribution to supplementing and sustaining spring Chinook and sockeye populations in the Wenatchee River watershed.

- Adult Spring Chinook trapping usually begins the 1st of June thru first Sept.
- Returning Spring Chinook are pitt tagged at the Tumwater Dam, Wenatchee River by the Rock Island Evaluation crew. Scales are collected from pitt tagged fish and sent to Olympia for determining origin. Tag data put into data base then sent to Chiwawa.
- We check every fish for pitt tags in the collection box and collect according to data showing from the tag.
- Allowed to collect a certain percentage of hatchery fish vs wild fish for brood stock, larger number hatchery fish return where excess are returned to river.
- Fish retained for broodstock spawning are trucked to Eastbank, fish not retained are trucked 10 miles upstream of the weir on the Chiwawa River.
- Hauled fish are transferred water to water.
- Spring chinook adults are held at Eastbank for spawning; eggs are also hatched and reared at Eastbank until Sept. when they are trucked to Chiwawa Ponds to be reared until release in April and May.
- We have two large rearing ponds at Chiwawa, one pond fish get volitionally released for a month and the other pond fish are forced out.
- Our fish collection weir is hydraulic (non toxic oil) we usually put the weir up 4 days per week, then lower for fish escapement upstream.
- Winter months the Chiwawa River gets frazil ice and snow which plugs pump intake screens.
- We are testing a water-warming unit to keep the intakes clean and free of snow and ice, using a certain percentage of alternate river water that is warmer, no ground water available.
- Lake Wenatchee adult sockeye are collected around mid July, transferred to offshore net pens for holding, then spawned on beach late Sept. early Oct.
- Eggs incubated at Eastbank as well as starting fish off there.
- Net pens set up mid June, then dismantled mid November.
- Sockeye reared in net pens July 1 thru second week Nov. Fish then released into lake.
- Sockeye usually come down with Columnaris when water temperature reaches upper 60 degrees.

Post-spawn Movement and Iteroparity of Hatchery-Origin Steelhead Kelts in the Central Valley of California

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Information on movement and iteroparity of steelhead, Oncorhynchus mykiss, kelts in California's Central Valley is sparse. We monitored the migratory behavior of steelhead kelts using ultrasonic telemetry. Ultrasonic transmitters were surgically implanted into twenty-five hatchery-origin steelhead kelts at the Coleman National Fish Hatchery (NFH) following the 2004/2005 spawning season. Tagged fish were subsequently released into Battle Creek, CA on 5 April 2005. Movements were monitored using a series of fixed-site receivers located throughout the Sacramento River and at the terminus of the San Francisco estuary at the Golden Gate Bridge. Migration behavior (i.e., travel distance, route and rate) was highly variable among individual fish; however, some patterns of movement were observed. Egress from Battle Creek ranged from 1 to 38 days (median 18 d) for fish exhibiting downstream movement. Two fish appeared to reside in Battle Creek or the upper Sacramento River through the fall of 2005. Downstream migration was generally rapid once initiated. Many tagged fish entered the San Francisco estuary and subsequently the Pacific Ocean by the end of May (average emigration rate approximately 8.8 km/d). Fifteen of the steelhead that entered the estuary were detected at Rio Vista (river km 19) indicating they emigrated through the mainstem Sacramento River, whereas three steelhead detected in the lower San Joaquin River likely emigrated through the interior delta. Freshwater reentry occurred from late-September through October. Nine of the 25 tagged fish (36%) were detected in the upper Sacramento River basin from October through December 2005; seven reentered the Coleman NFH, one fish was harvested by an angler, and the fate of one fish was undetermined.

Production Capacity Assessment of Steelhead at Hagerman National Fish Hatchery

Nathan Wiese* and Hagerman Hatchery Evaluation Team

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The Hagerman National Fish Hatchery (Hatchery) will rear 1.46 million steelhead smolts during broodyear 2006 with 62 cubic feet per second (cfs) of water in 198,000 ft^3 of rearing volume. Production occurs in first-use (upper), second-use (middle), and third-use (bottom) raceways. For the last five years, the Hatchery supply springs have decreased by 1 cfs of water per year. Because of this decline, the Hatchery has been researching production capacity limits. The Hatchery currently operates under a maximum Flow Index (FI) of 1.2 (0.9 kg/lpm) based on previous experience and tables from Piper et al. (1982), *Fish Hatchery Management,* with a water temperature of 15^0C and elevation of 3,000 feet.

The objective of this research was to determine the maximum carrying capacity expressed as a Flow Index. Operating near the production capacity limit increases the efficiency of the Hatchery and maximizes the potential capacity of the water supply. The Hatchery staff will use the results of this research to predict the impacts of decreasing spring flows and possible reductions in production capacity. To meet the objective, the Hatchery conducted a Production Capacity Assessment (PCA) as outlined in Meade (1989), *Aquaculture Management,* to determine the maximum carrying capacity of steelhead. The results of the PCA demonstrated that steelhead growth was inhibited at Flow Index of 1.5 (1.2 kg/lpm) in experimental tanks without supplemental oxygen (Figure 1).

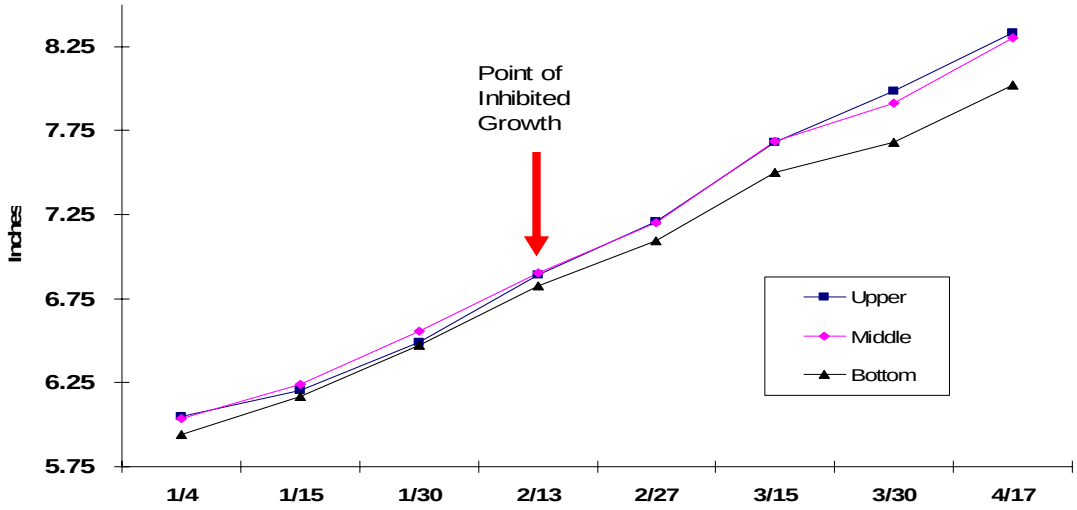

Figure 1. Steelhead length over time for Upper, Middle, and Bottom experimental production capacity assessment tanks and growth divergence after 6 weeks at a Flow Index of 1.48 at Hagerman NFH, BY 2005

POSTER SESSION ABSTRACTS

Techniques for Evaluating a Fry Release Strategy for Tule Fall Chinook Salmon at Spring Creek National Fish Hatchery

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Since its inception in 1901 and through the 1970's Spring Creek National Fish Hatchery performed fry releases which usually occurred during February in the Columbia River. The practice was curtailed in 1974 due to inadequate adult returns and reinstituted in the 1990's when the hatchery again experienced surplus returns. Past evaluations suggested that the fry releases Spring Creek NFH survived at a rate of 0.0022% during a study in the late 1950's and early 1960's. The addition of a warm water well provided the ability to manipulate incubation water temperature and use otolithography to mark fry destined for early release. With fry releases marked, we were able to measure their contribution to adult returns to the hatchery during recent years (Table 1). Over 3,000,000 fry were released during December of 1999, 2001, and 2002. Initial results suggest a survival rate of 0.021% for the 1999 brood year with analysis and returns for the 2001 and 2002 brood years partially completed. Survival of standard smolt production releases that occurred during March, April and May for brood year 1999 were 0.631%. Fry releases of tule fall Chinook salmon at Spring Creek NFH do contribute to adult returns but at a much lower rate than the standard production releases.

Table 1. Return of adults by age from a fry release of 3,116,006 during December 1999 at Spring Creek National Fish Hatchery. Adult tule fall Chinook salmon return to Spring Creek NFH during August and September. Survival of standard juvenile production during 1999 is given for comparison.

Age at Return	Return Years	Samples Collected	Fry Release Returns	Total Adult Return	Est. Fry Release Returns	Survival Rate of Fry Release	Survival of Standard Production
Age 2	2001	998	4	12,037	47	0.0015%	0.0749%
Age 3	2002	2,106	17	60,634	476	0.0153%	0.3774%
Age 4	2003	635	3	28,719	132	0.0042%	0.1788%

Adult Hatchery Fish in the Stream: An Evaluation of an Outplanting Program to Increase Natural Production

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The Confederated Tribes of the Warm Springs Reservation of Oregon and the United States Fish and Wildlife Service have implemented an adult outplanting program in Shitike Creek, a tributary of the Deschutes River in central Oregon. The goal of the outplanting program is to increase natural production of spring Chinook salmon by releasing adult hatchery fish from Warm Springs NFH into the stream and allowing them to spawn naturally. Radio-telemetry data indicated that hatchery fish actively searched for suitable spawning locations and constructed redds. The movement and behavior of outplanted fish varied according to the location and timing of release into the stream. Using redd counts in the Warm Springs River as an index, redd counts in Shitike Creek were higher during outplant years than would be expected if no outplanting had occurred (Figure 1). Differences in redd production due to outplanting by stream reach were observed and may be due to a variety of factors including the number of fish outplanted, habitat limitations, and the natural population of spring Chinook salmon in a particular reach. Pedigree analyses of juvenile outmigrants will provide information on the reproductive success of hatchery fish in the natural environment.

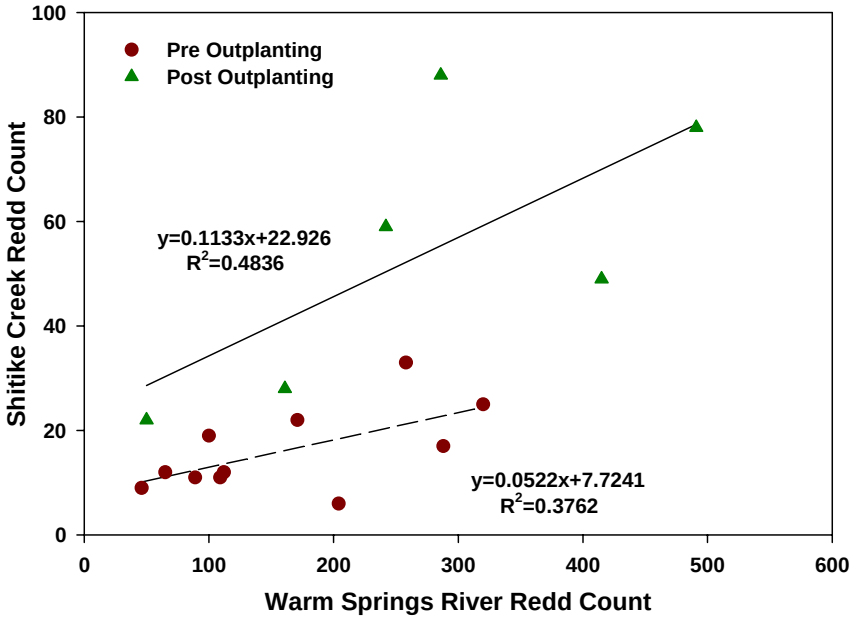

Figure 1. Relationship between redd counts in Shitike Creek and the Warm Springs River prior to outplanting (1989-1999) and after outplanting began (2000-2005).

Assessing the Impacts of Hatchery Released Fish on Native and ESA Listed Species

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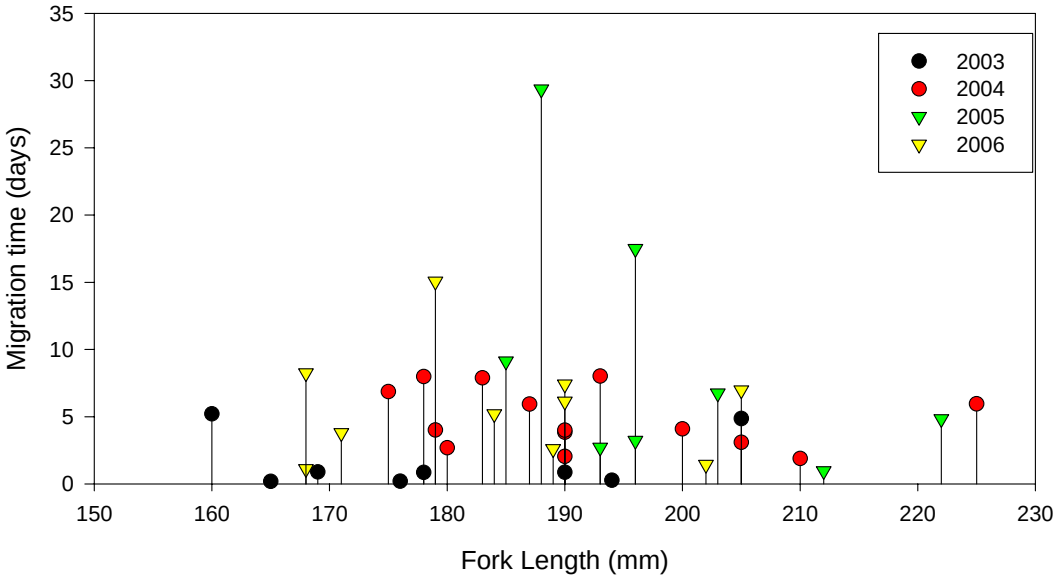
Eagle Creek National Fish Hatchery spawns and raises juvenile coho salmon *(Oncorhynchus kisutch)* and juvenile steelhead trout *(Oncorhynchus mykiss)* that are released into Eagle Creek within the Clackamas River basin, Oregon. The purpose of the program is to mitigate fish losses in the Columbia River Basin caused by hydro-power dams, to provide commercial, sport, and tribal harvest, and to support tribal restoration programs upstream of the Columbia River Dam. Limited information exists on the ecology and biology of wild fish in Eagle Creek and the impacts of hatchery management practices on wild fish behavior. The Columbia River Fisheries Program Office is undergoing a study to evaluate ecological interactions between hatchery and wild coho and steelhead populations in Eagle Creek. The objectives of the study are to 1) determine distribution, migration timing, and relative abundance of juvenile and adult winter steelhead and coho, 2) determine migration rate, movement, and residualism of juvenile steelhead and coho post volitional release from the hatchery, 3) work with the hatchery on evaluating alternative rearing environments, 4) work with the Lower Columbia River Fish Health Center to collect information on health and pathology of hatchery and wild fish, and 5) work with Abernathy Fish Technology Center to evaluate the genetic contribution of hatchery and wild fish to natural production in Eagle Creek.



Migration time from Eagle Creek National Fish Hatchery (Rkm 20.2) to the mouth of Eagle Creek (Rkm 1.1) for winter steelhead smolts volitionally released in 2003-2006.

The Effect of Erythromycin Feed Treatments on Prevalence of Bacterial Kidney Disease and Subsequent Survival of Spring Chinook Salmon at an Oregon Hatchery

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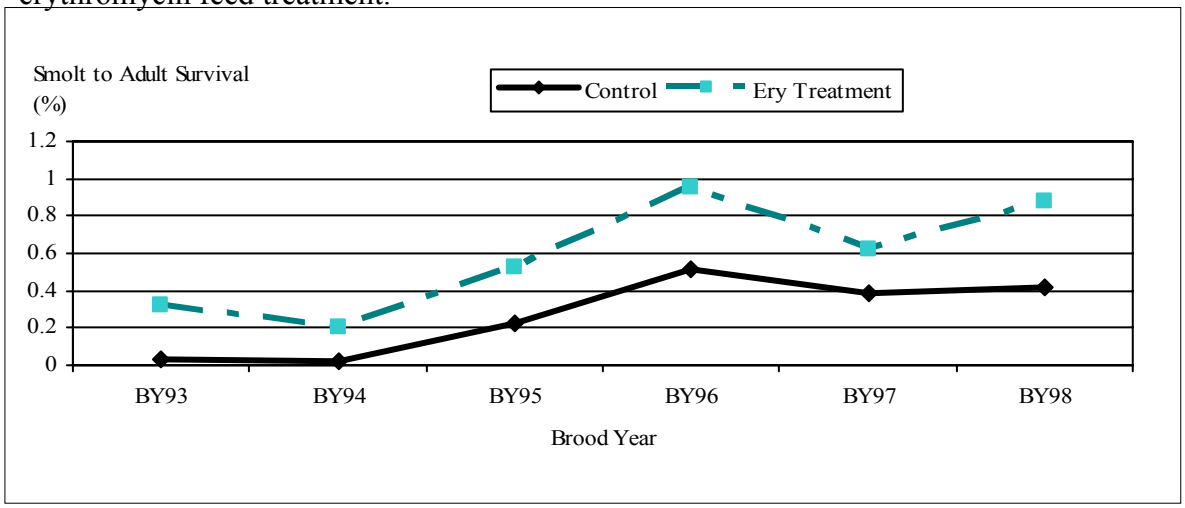
Spring Chinook salmon (*Oncorhynchus tshawytscha*) reared at Warm Springs National Fish Hatchery, Oregon are infected to varying extent with *R. salmoninarum.* This study was undertaken starting with brood year 1993 to determine the potential benefits of oral erythromycin treatment on 1) the survival of juveniles in the hatchery, 2) severity of bacterial kidney disease (BKD) as measured indirectly by the Enzyme-Linked Immunosorbent Assay (ELISA), and 3) survival to adult. Unique coded-wire tags were used to differentiate each brood year and study group. The drug administered was erythromycin thiocyanate (Aquamycin 100) incorporated in the diet by the manufacturer as either 2.25 or 4.5% Aquamycin 100. Although the feed type varied through the years, both the treated and control groups were always fed the same diets for the same number of days. Erythromycin therapy was administered in May and September from 21 to 28 days for each treatment. Drug concentrations in the diet and feeding regimes provided a daily dosage of 100 mg/kg body weight. Thirty juvenile fish from each raceway were assayed for BKD before and after each treatment and prior to release using the ELISA. Fish from all study groups were released on-station usually in mid-April during their second year of growth (typical spring yearling release). Adult fish from each release were recovered back at the hatchery after spending one to three years in the Pacific Ocean. There is a clear, consistent benefit to smolt to adult survival from using erythromycin medicated feed, even though the ELISA results did not show a consistent effect of treatment at the time of release. Future research at the hatchery will evaluate the benefit of a single May treatment vs. standard May and September treatments, as well as investigate methods for improved rearing and marking strategies as an alternative to erythromycin feed treatment.



Oregon Chapter of the American Fisheries Society

Oregon Chapter of the American Fisheries Society, P.O. Box 722, Corvallis, OR 97339

The mission of the Oregon Chapter of the American Fisheries Society is to improve the conservation and sustainability of Oregon fishery resources and their aquatic ecosystems for long-term public benefit by advancing science, education, and public discourse concerning fisheries and aquatic science and by promoting the development of fisheries professionals. Membership includes fisheries and aquatic science professionals from federal, state, and tribal agencies, colleges and universities, and diverse private employers, students, and retirees. Annual meetings are held each winter or spring with attendance recently exceeding 500 people. The Chapters next annual meeting will be held February 27 through March 2, 2007 at the Eugene Hilton and Conference Center, and in 2008 the Chapter will be hosting the Western Division meeting at the Doubletree Lloyd Center, in Portland on May 4 through 8, 2008. Annual meetings include pre-meeting workshops, a popular poster session and trade show social, regionally and nationally renowned plenary speakers, concurrent sessions with over 100 presentations, banquet, and awards. The Chapter also works on issues concerning Oregon's fish and aquatic resources, having a number of external committees, including fish culture, natural production, marine habitat & ecology, freshwater habitat, education & outreach, and legislative. To find out how you can be a part of this active fisheries organization, go to http://www.orafs.org

Effects of a Commercial All-Plant Protein Diet on Growth Responses and Tissue Contaminant Levels in Coastal Cutthroat Trout

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Due to its generally ideal amino acid profile, fish meal is the major source of protein in commercial salmon and trout feeds. Unfortunately, fish meal may contain high levels of contaminants such as PCBs and dioxins (see Hites et al. 2004) and fish will store these compounds when fed most commercial diets. Thus, palatable and nutritious feeds containing little or no fish products are needed. Use of vegetable protein diets should reduce tissue contaminant concentrations in hatchery-reared fish, as vegetable oils and meals (e.g. soybean meal) contain lower levels of contaminants. However, diets containing even moderate levels of plant products are often unpalatable to carnivorous fish, particularly salmon and trout. Such diets must therefore be evaluated in controlled feeding trials to determine whether they will produce an acceptable level of feed consumption and growth in fish.

A nine-week feeding trial was conducted at Abernathy Fish Technology Center to evaluate a commercial all-plant protein diet formulated for trout. A fish meal-based commercial trout diet served as the positive control treatment. Groups of 100 randomly selected juvenile cutthroat trout (initial weight was 10.1 g/fish) were stocked into 10 individual, 900L fiberglass tanks. Groups of fish in five randomly selected tanks were fed the all-plant protein diet and fish in the remaining five tanks were fed the control diet. At the conclusion of the feeding trial, weight gain and feed efficiency were significantly higher in cutthroat trout fed the control diet vs. cutthroat trout fed the all-plant protein diet. Survival and carcass proximate composition (protein, fat, ash, and moisture) were not significantly different between fish fed the two diets. Contaminant levels in fish fed each diet are currently being analyzed.

The Oregon Hatchery Research Center: Searching for Answers

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The Oregon Hatchery Research Center was officially opened in October 2005. The Center is a collaborative effort of the Oregon Department of Fish and Wildlife and the Department of Fisheries and Wildlife of Oregon State University. Our Mission is to understand mechanisms that may create differences between hatchery and wild salmon and steelhead, to develop approaches to best manage those differences to meet fishery and conservation objectives, and to help Oregonians understand the role and performance of hatcheries in responsibly using and protecting Oregon's native fishes. I will outline some of the research we have initiated towards that Mission. I will summarize preliminary results from studies of early development and behavior, stable isotopic analysis of diets, and feeding behavior of juvenile steelhead, Oncorhynchus mykiss. This research takes advantage of the specialized research facilities and capabilities of the OHRC, which combine experimental flexibility with capacity beyond that normally found in research facilities. Results of this ongoing research have a number of direct applications to both hatchery operations and fisheries management. Results from stable isotope studies can be used to resolve questions about the mechanisms of nutrient enhancement through salmon carcass distribution in coastal watersheds. Results from studies of early development and behavior can be applied to questions of hatchery production techniques, and the suitability of hatchery produced fish for restoration or enhancement programs. Analysis of stable isotopes links both these areas of studies, and is a powerful analytical tool for linking controlled experimental studies to large scale, long term environmental studies of salmon populations.

Columbia River Gorge Information & Education Office

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The Columbia River Gorge Information and Education (I/E) Office is located at the Spring Creek NFH, directly on the Columbia River, and provides year-round public outreach and education programs for Spring Creek and Carson National Fish Hatcheries and the Lower Columbia River Fish Health Center. The I/E Office has been providing outreach throughout the Mid-Columbia region since 1994. The small but highly skilled and motivated I/E Office is staffed by one full-time Information and Education Manager and one Northwest Service Academy AmeriCorps Volunteer working as I/E Assistant. Our goals are to provide activities that are informative and relevant to our local and visiting public, promote involvement, improve stewardship of our natural resources and bring a greater understanding of the complex issues involving salmon recovery in the Columbia Basin. We strive to promote awareness of the Columbia Gorge hatchery facilities and the mission of the USFWS. Outreach goals are met through a variety of on and off-site activities including: hatchery tours, school programs, information booths and presentations, annual open houses and free fishing days. Many of these programs are accomplished through a variety of partnerships.

Dworshak Fisheries Complex: Small town, Large fish, Big Complex, LOTS of Outreach

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Dworshak Fisheries Complex is located at the confluence of the North Fork and Main Clearwater Rivers in Idaho. The station is managed by the USFWS, and consists of 2 fish hatcheries, a Fish Health Center and a Fisheries Resource Office. A comprehensive Information and Education program was implemented in 1995 to provide outreach support for these offices. From the simple beginnings of offering guided hatchery tours to school groups and producing information handouts for the public, the program has grown to become part of the very successful and well-known Region 1 Fisheries Outreach Team. The Dworshak outreach program is managed by a full-time Information/Education Specialist and I/E Assistant, with help from hatchery staff and community volunteers. Dworshak Complex has developed unique and creative year-round approaches to educate the visiting public, partners and stakeholders, schools and local residents about Pacific Northwest fishery and watershed resources. Through innovative hands-on learning opportunities at the hatchery, in classrooms or at public events, diverse audiences gain a better understanding of how they can aid resource managers in meaningful conservation and stewardship of our natural resources.

Juvenile Pacific Lamprey Use of a Pollution Abatement Pond on the Entiat National Fish Hatchery

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The Pacific lamprey (*Lampetra tridentata*) is an anadromous species of fish impacted by many of the same factors affecting Pacific salmon, including loss of habitat and barriers to migration. Distribution and populations of Pacific lamprey have significantly declined in the Pacific Northwest during the last few decades. Artificial propagation and transplantation may be necessary for the restoration of Pacific lamprey populations in the Columbia River system upriver of Bonneville Dam.

Pacific lamprey ammocoetes have been observed in the pollution abatement pond at the Entiat National Fish Hatchery on the Entiat River, WA. On October 28, 2004, we partially drew down the pond and collected 123 juvenile lampreys (84 ammocoetes and 39 macropthalmia). Ammocoete densities in enclosures averaged 21.8/m^2 and the estimated population size was 36,450 ammocoetes (95% CI: 3,276 - 69,624), indicating the pond may have the potential to rear significant numbers of lamprey. We suggest it may be possible to rear juvenile lamprey in pollution abatement ponds at salmon hatcheries in the National Fish Hatchery System of the Pacific Northwest. This could provide a low cost technique to supplement or transplant Pacific lamprey in depleted watersheds. We recommend that investigations into lamprey use of the abatement pond at Entiat NFH be continued, and that feasibility studies of culturing lampreys be designed, funded, and implemented.

Leavenworth National Fish Hatchery Complex

Corky Broaddus*

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The Leavenworth National Fish Hatchery Complex (LNFHC) sits nestled in the heart of Washington's spectacular Cascade Mountains. This Hatchery Complex is managed by the U. S. Fish & Wildlife Service and is made up of the Leavenworth, Entiat, and Winthrop National Fish Hatcheries. The Leavenworth National Fish Hatchery Complex Information and Education Department manages one of the most diverse and unique interpretive educational outreach programs in the country. The energetic team of award winning outreach specialists is committed to providing high quality natural resource education and interpretation experiences to our visitors, volunteers and Friends support groups, schools, special event audiences, fellow agencies, and partners throughout north central Washington. Building and maintaining partnerships with media, Tribes, elected officials, and communities finds this organization creatively dealing with controversial issues and developing innovative approaches to educating the public. Effective public outreach and conservation education are critical for the continuing survival of fish and wildlife species and their habitats. Relationships we build and the public understanding we gain will help ensure a more secure future for America's fish and wildlife resources.

WE WOULD LIKE TO THANK THE FOLLOWING

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Warm Springs Reservation of Oregon - Pendelton, OR
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DoubleTree Hotel, Lloyd Center
Fish Brewing Co. - Olympia, WA
Franz Family Bakeries – Portland, OR
Friends of Northwest Hatcheries, Inc. – Leavenworth, WA
Full Sail Brewing Co.- Hood River, OR
G.I. Joe's – Portland, OR
Guide Shop/Clearwater Drifters - Orofino, ID
Hip Chicks Do Wine - Portland, OR
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Jim Minnick Custom Knives – Kamiah, ID
Kathryn Kostow, FCC logo artist
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Pacific Seafood International – Portland, OR
Paul Kaiser Wood Crafts - Quilcene, WA
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Red Lion Inn - Lewiston, ID
River Quest Excursions - Lewiston, ID
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Wenatchee River Salmon Festival – Leavenworth, WA
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Wildhorse Resort and Casino/Confederated Tribes
of the Umatilla Indian Reservation – Pendleton, OR
Young's Columbia Distributing – Portland, OR
Zoller's Outdoor Odyssey – White Salmon, WA

57th Annual Northwest Fish Culture Conference

Tradeshow Participants

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Water Management Technologies P.O. Box 66125 Baton Rouge, LA 70896	Terry McCarthy 225-755-0026
Western Chemical 1269 Lattimore Road Ferndale, WA 98248	Ron Malnor 360-384-5898

NORTHWEST FISH CULTURE CONFERENCE

HISTORICAL RECORD

YEAR	LOCATION	HOST AGENCY	CHAIRMAN
1950	Portland, OR	U.S. Fish and Wildlife Service	Ted Perry
1951	Wenatchee, WA	U.S. Fish and Wildlife Service	Roger Burrows
1952	Seattle, WA	Washington Department of Fisheries	Bud Ellis
1953	Portland, OR	Fish Commission of Oregon	Fred Cleaver
1954	Seattle, WA	U.S. Fish and Wildlife Service	Bob Rucker
1955	Portland, OR	Oregon Game Commission	John Rayner
1956	Seattle, WA	Washington Department of Game	Cliff Millenbach
1957	Portland, OR	U.S. Fish and Wildlife Service	Harlan Johnson
1958	Seattle, WA	Washington Department of Fisheries	Bud Ellis
1959	Portland, OR	Fish Commission of Oregon	Ernie Jeffries
1960	Olympia, WA	Washington Department of Game	John Johansen
1961	Portland, OR	Oregon Game Commission	Chris Jensen
1962	Longview, WA	U.S. Fish and Wildlife Service	Roger Burrows
1963	Olympia, WA	Washington Department of Fisheries	Bud Ellis
1964	Corvallis, OR	Oregon State University	John Fryer
1965	Portland, OR	U.S. Fish and Wildlife Service	John Halver
1966	Portland, OR	Fish Commission of Oregon	Wally Hublou
1967	Seattle, WA	University of Washington	Loren Donaldson
1968	Boise, ID	Idaho Department of Fish and Game	Paul Cuplin
1969	Olympia, WA	Washington Department of Game	John Johansen
1970	Portland, OR	Oregon Game Commission	Chris Jensen
1971	Portland, OR	U.S. Fish and Wildlife Service	Marv Smith
1972	Seattle, WA	Washington Department of Fisheries	Dick Noble
1973	Wemme, OR	Oregon Fish Commission	Ernie Jeffries
1974	Seattle, WA	University of Washington	Ernie Salo
1975	Otter Crest, OR	Oregon State University	Jack Donaldson
1976	Twin Falls, ID	University of Idaho	Bill Klontz
1977	Olympia, WA	Washington Department of Game	Jim Morrow
1978	Vancouver, WA	U.S. Fish and Wildlife Service	Dave Leith
1979	Portland, OR	Oregon Department of Fish and Wildlife	Ernie Jeffries

YEAR	LOCATION	HOST AGENCY	CHAIRMAN
1980	Courtenay, B.C.	Fisheries & Oceans, Canada	Keith Sandercock
1981	Olympia, WA	Washington Department of Fisheries	Will Ashcraft
1982	Gleneden Beach, OR	National Marine Fisheries Service	Einar Wold
1983	Moscow, ID	University of Idaho & Idaho Department of Fish and Game	Bill Klontz & Evan Parrish
1984	Kennewick, WA	Washington Department of Game	Jim Gearheard
1985	Tacoma, WA	U.S. Fish and Wildlife Service	Ed Forner
1986	Eugene, OR	Oregon Department of Fish and Wildlife	Chris Christensen
1987	Tacoma, WA	Washington Department of Fisheries	Will Ashcraft
1988	Richmond, B.C.	B.C. Ministry of Environment	Don Peterson & Peter Brown
1989	Gleneden Beach, OR	National Marine Fisheries Service	RZ Smith
1990	Boise, ID	Idaho Department of Fish and Game	Bill Hutchinson
1991	Redding, CA	California Department of Fish and Game	Ken Hashagen
1992	Wenatchee, WA	Washington Department of Wildlife & Alaska Department of Fish and Game	John Kerwin & Irv Brock
1993	Spokane, WA	U.S. Fish and Wildlife Service	Ed Forner
1994	Sunriver, OR	Oregon Department of Fish and Wildlife	Rich Berry
1995	Fife, WA	Washington Department of Fish and Wildlife	Larry Peck
1996	Victoria, B.C.	B.C. Ministry of Environment, Lands and Parks & Department of Fisheries and Oceans Canada	Don Peterson & Greg Bonnell
1997	Gleneden Beach, OR	National Marine Fisheries Service	RZ Smith
1998	Boise, ID	Idaho Department of Fish and Game	Tom Rogers
1999	Seattle, WA	U.S. Fish and Wildlife Service	Ray Brunson
2000	Sacramento, CA	California Department of Fish and Game	Judy Urrutia
2001	Portland, OR	Oregon Department of Fish and Wildlife	Trent Stickell & George Nandor
2002	Bellingham, WA	Washington Department of Fish and Wildlife	John Kerwin
2003	Portland, OR	NOAA Fisheries- NW Region & NW Fisheries Science Center	RZ Smith & Tom Flagg
2004	Victoria, B.C.	Freshwater Fisheries Society of BC & Department of Fisheries and Oceans Canada	Ray Billings & Roberta Cook

YEAR	LOCATION	HOST AGENCY	CHAIRMAN
2005	Boise, ID	Idaho Department of Fish and Game	Tom Frew Tom Rogers Lynette Moran
2006	Portland, OR	U.S. Fish and Wildlife Service	Doug Olson Craig Martin Amy Gaskill

The People Producing Salmon
By Kathryn Kostow

"The People Producing Salmon" is inspired by the art of Northwest Native Americans. It represents a team effort between the human people and the salmon people to produce salmon. Since it was created for the 1997 Northwest Fish Culture Conference, it can be taken as a literal "production" of salmon. Alternatively it can represent the broader effort underway in the Northwest to improve conditions for, and therefore the production of, salmon.

The salmon people are represented by a ripe father salmon (in blue) and mother salmon (with red eggs). They carry in their bodies the essence of their people spirits, represented by the faces in their eyes and hearts. Of course, the salmon people are the star players in the production of salmon.

The human hands, passing eggs and milt, represent the human involvement in the production of salmon. But the human face in the center looks both concerned and uncertain. In the head of the human is the concept of salmon, but the concept is confused and incomplete. These aspects represent the concern, but also the debate and uncertainty, inherent in our efforts to improve Northwest salmon populations.

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U.S. Fish and Wildlife Service
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For 57th Annual Northwest Fish Culture Conference Information
http://www.fws.gov/nwfcc2006/

The mission of the U.S. Fish and Wildlife Service is working with others to conserve, protect and enhance fish, wildlife, plants and their habitats for the continuing benefit of the American people.

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